

Thermal insulation composite with improved heat resistance and improved fire performance

Description

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The invention relates to a thermal insulation composite, comprising two metal sheets with a thermally insulating core material, wherein a fire-protection layer has been introduced between the thermally insulating core material and at least one of the metal sheets, to a process for its production, and to its use for the production of storage buildings or of cold-store buildings.

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Sandwich panels composed of a thermally insulating core material and of bilaterally adhesive-bonded sheets of steel or of aluminum are used as structural elements or cladding in construction applications. Their heat resistance in the event of a fire is often inadequate. For example, in the event of a fire thermoplastic foams can melt merely as a result of exposure to heat, and impair the mechanical stability of the sandwich panels.

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WO 02/064672 therefore proposes the use, as core material, of a polymer foam with a continuous phase composed of a phenolic resin and of dispersed polystyrene foam beads.

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GB-A 2362586 discloses a process for improving the flame retardancy of polystyrene foam slabs, in which the prefoamed polystyrene foam beads are coated with a liquid phenolic resin which comprises a flame retardant based on phosphorus or chlorine compounds, and are then fused to give slabs. However, these flame-retardant polystyrene foam slabs can be lost via melting on exposure to relatively high temperatures for a prolonged period.

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DE-A 196 39 842 discloses fire-protected composite systems composed of polystyrene foam slabs whose surface has been provided with profiles or with grids or nets, this having been saturated with an intumescent composition. The profiles, grids, or nets are preferably introduced into the joints between the foam sheets.

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EP-A 0 942 107 describes a foam impregnated to give flame retardancy and in essence consisting of PU foam, which is laminated to two self-adhesive films, between which an intumescent material has been enclosed, and its use as fire-protection stopper.

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It was therefore an object of the present invention to eliminate the disadvantages mentioned and to invent a thermal insulation composite with improved heat resistance and improved fire performance, and a process for its production.

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The thermal insulation composite described at the outset has accordingly been invented. The metal sheets of the thermal insulation composite are generally composed of steel or of aluminum with a thickness of from 1 to 10 mm

- 5 The thermally insulating core material may be composed of molded polystyrene foam, of extruded polystyrene foam sheets (XPS), of polyurethane foams or of PIR foams, or of mineral wool. Preference is given to a thermally insulating core material composed of molded polystyrene foam sheets, obtainable via sintering of prefoamed polystyrene foam beads composed of expandable polystyrene (EPS), because this core material
10 has low density together with processability and longlasting insulation performance. Preference is given to molded polystyrene foam sheets whose density is in the range from 10 to 50 g/l and whose thickness is in the range from 50 to 250 mm.

- 15 The fire-protection layer applied to the molding may take the form of laminate, sheet, film, dispersion, or solution. The thickness of the fire-protection layer depends on the material used and is generally in the range from 0.1 to 50 mm, preferably in the range from 1 to 10 mm. An example of a suitable material is a foam film composed of a heat-resistant melamine resin foam (e.g. Basotect®) or a fire-protection laminate composed of gelled alkali metal silicate solution (e.g. Palusol®). The thermally insulating core material is preferably coated with an intumescent composition. The coating may be applied by spraying, immersion, roller-application, or spreading, to one or more surfaces
20 of the thermally insulating core material. The coating material itself is flame-retardant. The result is that the heat-sensitive core material situated thereunder is protected from high temperatures and from flashover, and retains its structural integrity.

- 25 Intumescent compositions are materials which foam on exposure to relatively high temperatures, generally above 80 -100°C, and during this process form an insulating and heat-resistant foam which protects the thermally insulating core material situated thereunder from exposure to fire and to heat.

- 30 The intumescent composition present in the thermal insulation composite is preferably an alkali metal silicate, in particular a hydrous sodium silicate, expandable graphite, or expandable mica.

- 35 The inventive thermal insulation composite may be produced via bonding of two metal sheets and of a thermally insulating core material, where a fire-protection layer is introduced between the thermally insulating core material and at least one metal sheet, preferably between the thermally insulating core material and both metal sheets. Commercially available machines for producing thermal insulation composites may be
40 used for this purpose.

In one preferred process, an intumescent composition is used to coat at least one surface of the thermally insulating core material, and the material is then adhesive-bonded to the metal sheets. It is also possible to mix the intumescent composition with the adhesive and to apply the materials together to the thermally insulating core material or to the metal sheet, or to use an intumescent composition which has sufficient adhesion to the metal sheet.

The adhesives used may comprise single- or two-component adhesives based on polyurethane resins or on epoxy resins. However, it is also possible to use adhesives based on dispersions, e.g. acrylate dispersions (Acronal®).

In one embodiment, the adhesive forms all or part of the fire-protection layer. To this end, additives, such as expandable graphite, hydrous sodium silicates, zinc borates, melamine compounds, metal hydroxides, or metal salt hydrates, or a mixtures of these, are admixed with the adhesive. The proportion of the additives is generally in the range from 2 to 98% by weight, preferably from 40 to 90% by weight, based on the adhesive. To improve processability, e.g. during the spreading or spraying process, or to accelerate drying, or to improve adhesion, other conventional fillers may be admixed with the adhesive.

In one preferred embodiment, the fire-protection layer is formed from an intumescent composition based on a sodium silicate. To this end, use is made of a commercially available waterglass solution with a water content of about 65% by weight, and this is mixed with waterglass powder with a water content of about 18% by weight. The gelling times for the mixture can be adjusted as desired by way of the amount of waterglass powder. If appropriate, amounts of from 0 to 50% by weight of inorganic fillers, such as metal hydroxides or metal sulfate hydrates, or else up to 10% by weight of organic fillers, may be added to the mixture. The liquid mixture may be directly applied or sprayed onto the sheets of the panel core material. The coating layer thicknesses here may be from 0.05 to 5 mm.

The gelling takes place at room temperature, but can be accelerated by exposure to higher temperatures up to 80°C. The sheets of the core material are thus coated on all sides, or only on the broad sides subsequently used for adhesion to a metal sheet.

It is also possible to coat the thermally insulating core material with the waterglass mixture and to press it with the metal sheets on both sides prior to complete gelling.

The exposed edges and corners of the core material not covered by the metal sheets may also likewise be provided with the coating composition, or critical points, such as ends or joints, may be protected from exposure to heat or from flashover via introduction of insulating wedges composed of mineral wool into the panel structure. The foam-

ing of the coating can also seal apertures produced and thus inhibit flashover into the core material.

- 5 The inventive thermal insulation composite is preferably suitable in the construction industry, for facade cladding, or as what are known as "structural insulation panels" for the production of storage buildings or of cold-store buildings.

Examples:

10 Inventive example 1:

- 15 A molded polystyrene foam sheet composed of EPS (600x1000x100 mm) with a foam density of 18 g/l was provided on both sides with a layer, thickness 2 mm, of a water-glass mixture, composed of waterglass solution (water content 65% by weight) mixed with waterglass powder (water content 18% by weight). After gelling and hardening of the layer, the resultant sheet was coated on both sides with a layer, thickness 50 μ m, of a PU adhesive, and steel sheets, thickness 1 mm, were applied by adhesive bonding. In order to assess heat resistance and flame retardancy, the resultant panel was secured horizontally after the adhesive had hardened, and exposed for 30 minutes to a gas flame (flame temperature $>500^{\circ}\text{C}$) from below. Only a small proportion of the EPS foam core material melted during the entire 30-minute period of the test, and the material did not ignite. The foaming protective layer composed of waterglass substantially inhibited damage to the core material, and the structural integrity of the panel was retained.

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Comparative experiment

- 30 A molded polystyrene foam sheet composed of EPS (600x1000x100 mm) with a foam density of 18 g/l was provided on both sides with a layer, thickness 50 μ m, of a PU adhesive, and steel sheets, thickness 1 mm, were applied by adhesive bonding. In order to assess heat resistance and flame retardancy, the resultant panel was secured horizontally after the adhesive had hardened, and exposed for 30 minutes to a gas flame (flame temperature $>500^{\circ}\text{C}$) from below. After as little as 5 minutes, the EPS foam core material melted and ignited, and the structural integrity of the panel was lost.